

Project Number: 51 -JMW DHSC

A FUTURE SCIENTISTS AND ENGINEERS

CLUB FOR DOHERTY HS

An Interactive Qualifying Project Report

submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

Orry Cummings

Christopher Norton

Date: October 26, 2007

Professor John Wilkes, Advisor

Transcript Abstract (62 words)

A "Future Scientist and Technologists Club" was continued and expanded upon to inform students at Doherty High School about the fields of science, technology, and engineering to help them pursue technical careers. This report examines the logic behind the creation of such clubs and describes the actual club meetings that were held this year. This program was very helpful to the students and should be continued.

Report Abstract

A future scientist and technologist after school club was designed to assist the students of Doherty High School in learning more about fields of science, technology, and engineering. This project was based off of a pilot program conducted last year where student involvement and interest were very high. Attention was paid to the gender of the participants in the club because of the history of male dominance of the fields of science, technology, and engineering. The ability of this club to provide a plethora of information to aspiring scientists and engineers that is not offered to them in their normal school curriculum is what makes it extremely valuable. We hoped to increase and re-enforce existing interest in technical careers, so that more students will follow through and major in one of these fields at the college level.

Acknowledgements

We would like to thank the following individuals for their advice and support throughout our project.

We would first like to thank Professor John M. Wilkes, our project advisor as well as our co-advisor Elizabeth Tomaszewski for their support through our entire process from planning to implementation. Without their help this club would not have been possible. Their involvement helped our team to get the first of what we hope will be many field trips to WPI for the future scientist and technologist club.

We would also like to thank our sponsor, the members of the City Manager's Advisory Committee on the Status of Women.

Last but not least, we would like to thank our outstanding advisor at Doherty High School, Kathy Kambosos. It was with her help that we were able to keep the club attendance up and keep the students excited about the club. We would like to also thank her for her help in getting clubs started at the other Worcester High Schools.

Table of Contents

Chapter 1. Introduction:

1.1 Project Sponsor.....	6
1.2 Evolution of Goals.....	12
1.3 Goals.....	14
1.4 Overview.....	15
1.5 Issues.....	16
1.6 What We Hope To Achieve.....	23

Chapter 2. Planning and Implementation:

2.1 Initial Planning.....	27
2.2 Plan One.....	29
2.3 Plan Two.....	31

Chapter 3. Implementation:

3.1 Meeting A (01/31/07):.....	32
3.2 Meeting 1 (02/07/07):.....	34
3.3 Meeting 2 (02-28-2007):.....	37
3.4 Meeting 3 (03-14-2007):.....	40
3.5 Meeting 4 (03-22-2007):.....	43
3.6 Meeting 5 (03-28-2007):.....	46
3.7 Meeting 6 (04/04/2007):.....	50
3.8 Meeting 7 (04/11/07):.....	58

Chapter 4. Conclusions:

4.1 Recommendations.....	61
4.2 Overall Conclusion:.....	64

References.....	69
------------------------	-----------

APPENDICES:

APPENDIX A:.....	70
APPENDIX B:.....	71
APPENDIX C:.....	73
APPENDIX D:.....	74
APPENDIX E:.....	75
APPENDIX F:.....	76
APPENDIX G:.....	83
APPENDIX H:.....	85

1. Introduction

1.1 Project Sponsor

The project's sponsor for this year (as well as last) was the Worcester City Manager's Advisory Committee for the Status of Woman (ACSW). They are involved in the project due to issues with gender inequality within engineering. This is one problem that is being addressed through the implementation of the science and technology club, which can help to stimulate the interest of women in engineering by providing information regarding careers that cater to their interests. A study performed by Nora Rizkalla and Zachary Gautreau, presents the results of a survey given to 8th graders that is similar to one given to the 11th graders of Worcester by Marsland et al. The goal of this is to compare the information received and attempt to draw conclusions based on the data.

Of concern were the two subjects most important in preparing for a career in engineering and technology, science and math. The data taken from 8th graders suggests that while a gender bias does exist with regard to interest in mathematics, science is reported by 20% of both males and females to be their favorite subject. The 11th grade data suggests that the number of students who indicate science as a potential career choice is a mere 5%; however, 20% of the males express interest in engineering compared to 5% of females. It is interesting to note that approximately three times as many females as males express interest in entering a medical profession by the 11th grade. Nora hypothesizes that the interest in science for the 8th graders

translates into biology for the females and physical sciences for the males for reasons related to gender stereotyping. However, at that grade level Worcester is offering an integrated science course that involves exposure to physical sciences other than just biology.

Judging from the results it would appear as if the critical time in which their interest in science related subjects is reflected by the data is between the 8th grade and 11th grade. Early high school, 9th and 10th grade, must be when the major decline in interest occurs. Not only does this overall decline in interest in science occur, but also it affects the females more than the males. No definite reason was offered by Rizkalla and Gautrean for the decline of interest in technical careers among the females being greater than among the males, but it is thought that this decline from the point that has science as the “favorite” subject is due to the introduction of chemistry and physics in high school. Science throughout middle school is a combination of disciplines that emphasizes biology, chemistry and Earth science. In high school, specifically 11th grade, the majority of students are enrolled in either chemistry or a physics class that is vastly different from the descriptive biology the 8th graders experienced. Our theory is that science has taken on a different meaning, partially resulting in the decline found in the data, but that science did not have to get abstract and math based at that point. That was a policy decision by the school system based in part on available texts. Actually, the chemistry in the community text and active physics tests developed by the ACS and AID respectively keep science relevant and interesting though high

school. They foster technological literacy from the general population rather than preparation for a college major, but cover all the necessary concepts while avoiding the “turn off” Worcester could adopt these texts. Actually WPI has dropped Physics as a requirement for admission because in some field advanced biology on anatomy and physiology as equal more relevant. Also the physics faculty report so many misconceptions among freshmen who supposedly took high school physics that it is probably better that they start out fresh with subject as college freshmen experiencing it presented in a way designed to support later engineering course work. With only twenty to thirty percent of high school students taking physics anyway WPI could not limit itself to so small a pool of talent given the range of majors offered, which include: management, math, computer science, as well as engineering.

The small school system in place in the Worcester Public Schools is at odds with policies that place 8th grade students into the respective high schools based on their residence within the district rather than their interests. In the system there is currently only one small school that caters to those interested in engineering. This small school, the Engineering and Technology Academy (ETA), is located at Doherty High School. In principle, those interested in engineering are encouraged to enroll in this academy, which will govern their high school class schedule, but in practice (according to Rizkalla and Gantreau) few 8th graders (20%) are aware of the small schools and even

fewer are prepared to leave their districts and hence their middle school friends.

If the students interested in technology had clustered around ETA, one would think that there would be little interest in future scientist and technologist clubs in the other schools. However, knowing what is really happening one would expect about 75% of the students interested in technical fields to be in the other high schools. Marsland et al's aspiration survey results show that this is what one finds, and that more than a few students at each high school are interested in a technical profession.

The students with technical interest have not concentrated at ETA, so the WPS administration should have to reach out to them and provide information and support. In a way the WPI club project is the ETA outreach program. It was at the WPI field trip this year that the Doherty Students in ETA met the students interested in engineering from the other high schools for the first time.

In the case of North High, not all of the Club members aspired to be engineers. They are browsing their career options and some are equally interested in medicine. Keeping one's options open at that age is something we tried to encourage. We were told that with some modifications, such as a different meeting time that has fewer time conflicts with other activities, attendance at our club meetings should increase substantially. The club advisors at North stated that they believed a good number of students who they felt would ordinarily attend were involved with other after school

activities. If so, just a portion of the pool of students interested in technology at this high school was enough to support a club. One aspect of this project that was controversial was how an all male (football players not stereotypical nerd) group of WPI engineering students would be received by the high school females we wanted to support and encourage in their technical interests.

Since one of the goals was to attract females who were interested in exploring the possibilities in technical fields, it was thought that a team of Club leaders including one male and one female would be more successful than an all male team. It was for this reason that the great success of the Doherty club with females as well as males came as a surprise to all those involved. The team at Doherty succeeded in attracting anywhere from thirty eight percent on the lower end to forty six percent females at the high end to the Club meetings. While it is important to involve WPI females, and future clubs would benefit from female role models, the results achieved this year without them are encouraging. This good start should not be undermined by taking a year off next year if no WPI female club leaders are available. The project is still in the building phases and the positive image of a technical career portrayed this year was an important one. It should be built on immediately.

The goal of fostering gender equality is not dependent on having females from WPI set up clubs. Judging by the success of this year, it would be beneficial overall to seek equal male and female teams in the future. Typically, engineers have gotten the image of being nerdy and unable to

effectively communicate with others. This is an image that is usually untrue, one that we wished to dispel and we think we dealt with that issue quite successfully.

1.2 Evolution of Goals

This project was built around the concept and experience of last year's "Future Scientist and Engineers Club" created by Matthew Duncan and Brian Dorchik. Their clubs focus was to inform students at Doherty High School in Worcester about fields of Science and Engineering. This year the Doherty club evolved into the Future Scientist and Technologist Club initiative and clubs were created at all five of the Worcester High Schools. The general motivation of the group was to continue that work that was done last year and expand it to the other schools while also building a stronger base at Doherty High School. Doing this would make the club permanent with the help of WPI students and also to set the initial ground work at the other four Worcester Public Schools so that they would be able to have continuing clubs in the future.

Our initial goals required us to establish contact with a few already existing faculty and staff at North and Doherty and establish many new connections with faculty and staff in schools that were not yet involved in the program. With these contacts we would be able to set up the clubs at the schools and also be able to establish a lasting bond between the Worcester public schools and WPI. Also the contacts at the schools would be instrumental in the recruiting students for the clubs, so as to make them a success.

One goal of last year's project that was not completed was to have a field trip to WPI. Last year because of lack of time and resources the field trip was never made possible. Given this year's larger team and earlier start in the school year, we knew that we could make this field trip happen and hoped it would

become an annual event between WPS and WPI. Our initial intention was to provide a tour of lab facilities as proposed by last year's team. However, this proved harder than they implied. What was easier and possible with our contacts was to piggyback on the Student Pugwash association's Space Conference, we changed our plans to bring the high school students to campus for this event featuring presentations by space policy and technology IQP teams.

Another main goal of this project was always to excite the student's interest in engineering and science related fields and to help them make their way into a college career in one of these fields. This was a primary focus of the club from the beginning and our group spent the most time designing activities around that goal.

1.3 Goals

To sum up, the goals of the group our main focus was to go into Doherty High and continue that science and technology club there, to teach and excite the students about science and technology related fields, and to expose in particular the options of engineering fields to young women who show interest in these fields. We also wanted to build onto the existing group of students that were involved in the club last year. Along with the continuation of the club at Doherty our larger team initiative was expanding the club to the other four Worcester Public Schools and building lasting relationships there with faculty in the science and math departments. Other objectives of the club were to get a field trip started that would continue to be an annual event as well as involve WPI professors to increase the depth of knowledge.

1.4 Overview

The Project proposed to us was that five Worcester Public Schools with different small schools focusing on different interests had all been given a survey. From that survey it was found that the percentages of students interested in science and engineering was even across the board, rather than being concentrated in Doherty High where the Engineering and Technology Academy (ETA) is located. Another statistic revealed by the survey was that many more females expressed an interest in science and technology than the team or high school administration anticipated when the survey was performed.

Therefore our services were needed to provide a forum for these students interesting in science and technology which allowed them to explore those interests in an after school club because the school itself did not cater to their interests in this area. Our intentions were also to focus on the women at the school to see if the proportion of women found to be interested in engineering through the survey was the same that appears in our club meetings.

Another area of interest aside from the students that was being examined was the amount of approvals needed to get an afterschool club accepted by the overall Worcester Public School system including teachers, principals, and superintendent. The prior project by Duncan and Dorchik was nearly killed by the process they went through, and we were trying to set up at different schools. The North High Project prior year had failed due to administrative delay.

1.5 Issues

The biggest issue that we had dealt with involved the time required to receive approval to get into the school. For this reason it proved extremely difficult to organize presentations by WPI faculty because we could not get them an exact startup date, or schedule of meetings, and to meet and discuss possibilities with the club advisors, and plan the field trip. A little foresight by the group could have eliminated this problem. However, since a Create a Club project had never been undertaken on this scale before (4 schools at once) it is understandable that some issues due to lack of experience would emerge. Discussed below will be the proposed solutions that should help to alleviate these problems for next year's group.

The first requirement to get into the schools is submission and approval of the CORI background check. This background check takes several weeks and in our cases partially delayed our initial entrance into the school as no volunteers are allowed into the schools without an approved CORI. While a few CORI forms were processed at the end of last year in anticipation of this project the upcoming year, the majority were not and the slow turn around time was an issue. Since the interested individuals have already been identified for next year, it would be recommended that their CORI forms be submitted before the end of the school year to the WPS so that they have the opportunity to step foot in the schools and get things organized upon arrival in the fall.

It was this large time delay getting all of the necessary approvals that impeded the scheduling of meetings that included demonstrations from the WPI

faculty. Some hesitation was also present on the part of the WPI faculty to perform the same demonstration five times over in each of the respective schools. This issue could be avoided next year, by identifying a large pool of faculty members who would be willing to perform their demonstrations perhaps one or two times per semester at the various schools. With this sort of rotation in place it is possible that the clubs may not be able to hear from the entire identified faculty, but this format would provide more diverse topics over several years.

One problem that was encountered this year with Doherty especially was the emphasis on not repeating anything that had already been done last year. Since the club is open to freshman, sophomores, juniors, and seniors, it is quite possible that students might be subjected to the same presentation repeatedly if a standard program, like a course, was developed. For fear of driving students away with repeated presentations, a rotation of presentations or presenters should guarantee that no student will see a presentation on the same subject, done the same way more than twice assuming a four year participation in the club. Being involved for that long is really not considered likely at this time. The Doherty club catered to freshman and sophomores, with few juniors involved last year. This year at least the freshmen were expected to return. Actually, it was an all new group except for three students, but in principle, repetition in two successive years could be a future problem and should be considered when scheduling presentations.

The third issue also deals with the presentations, specifically the ones given by the students. During the initial planning stages of the project, many ideas floated around centering on our experiences at WPI and how we could relate what we had learned to the clubs through presentations and lecture. The club advisors as well as our own experiences showed that this was a rather ineffective way to go about determining the schedule of presentations throughout the duration of the clubs program for the year. It would prove more interesting for both parties if a mutual agreement were reached between the club advisors and the WPI students with regards to the topics to be covered. An agreement in which the presentations were split between topics which the WPI students wished to speak about and the topics that the club members wished to hear would simultaneously spur interest in engineering while still addressing subjects of known or likely H.S. student interest. Presenters must be aware that one is not talking to people whose education has been technically oriented. Freshmen and sophomores are still thinking about engineering school and have not even taken the more advanced science and math classes yet. The majority of the engineering oriented subjects popular at WPI will be new and many will be overly complicated for this audience. It was important, then, to get feedback from the students. It is recommended that a topic selection system be implemented to address the wishes of both involved parties.

Another issue was the field trip. The general consensus was that the field trip to WPI could have been better scheduled and tailored to the students' interests. The on-campus Space Technology and Policy conference dealt with

living and working on the Moon and Mars. It was designed for an on campus audience. Most of the speakers were drawn from teams working on IQP's in this area. The Student Pugwash Organizers were space enthusiasts. Those individuals were responsible for planning on campus activities for WPI students. A few of the topics were general and basic, but some were not. The first presentation that the students saw was on fusion reactors, which was particularly technical. Specifically, the high school students were a bit overwhelmed technically and the subject was not a good fit for most of them. The high school students brought little or no background to the pace conference discussion.

The conference atmosphere was rather intimidating, being seated in a large lecture hall with a video camera taping while various parties shared the results of their year-long and very specific research topics. The high school students needed a general overview or introduction by a faculty member first. This sort of setting seemed rather counterproductive to attract high school students. Worse, the first group did not give a practiced presentation, further increasing the stereotype that engineers are nerdy individuals who have a hard time conveying their ideas. Luckily the rest of the presenters were better. WPI student classes determined the schedule rather than which presentations would appeal to high school students the most.

The students got more out of the general admissions tour and videotape, though the speaker that came up just as they were leaving was so good that many wanted to stay. Unfortunately they were not allowed to hear the end, due to the bus schedule. The logistics were poorly planned for our audience. We

should have planned our own event speakers and schedule, drawing on the whole campus not the one event.

For the future, we recommend that the students not be subjected to specific Student Pugwash space, nuclear power, intellectual property, or whatever conference theme presentations there are for no longer than one hour. They should just come for the keynote speaker rather than the project reports. The rest of the time can be focused on various lab demonstrations. WPI has a lot to offer in terms of labs that can put on extremely interesting demonstrations that would most certainly hold the attention of the students as well as generating interest in the fields that need such facilities.

Efforts were made this year to set up some lab visits, but it takes far more time and planning than expected to organize fire or computer game lab demonstrations. The FACES program for high school women designed by Laura Handler and Pat Hogan in 2004 with groups going to see the robotics lab, fire lab, and prosthetic design lab was more effective than our field trip.

Funding proved at one point to be a greater issue than was realized at the beginning of the project planning. It was originally assumed that each student would contribute \$75, totaling \$150 dollars per group that would in turn be matched by the WPI IGSD office, providing a budget of \$300 dollars per group for various expenses. Due to delays and a sloppily written proposal, this was a resource that remained untapped. Despite getting the IGSD to provide money for the field trip transportation, having a more professional proposal that better communicated the goals of the club and how the money would be used in a

constructive fashion would greatly improve the chances of success receiving funding for activities. However, one thing we wanted to fund is a lost cause. We learned that there is no way that WPI is going to pay for high school faculty members to advise these clubs, no matter what the Worcester public school union rules say. The WPS will have to deal with the staffing pay issue on their end. About 60% of the funding request was thus dismissed out of hand. Somehow that got approved last year when only one club was involved, but the money was never spent, so a precedent was not set the year before and our request was disapproved.

The last issue was the time frame in which this project took place. It was scheduled for WPI's B, C, and D terms, which loosely corresponds with the academic schedule of the WPS except that it did not involve a start in September when the students are joining clubs for the year. There might be a better turnout for club meetings if the club started earlier and was run for one of the high school semesters about one half of the WPI year, such as A, B and C or C and D term, since this is approximately one half of the WPS school year. Since WPI's year ends in early May and the public school year runs until late June a case can be made for an A term start. This should attract students before they become involved in other club activities, and ensure that a half year program at WPS is within the WPI school year. It allows time for write up in WPI C and D terms.

The reason this is recommended is due to the response that was received this year. Having a predetermined meeting date of Wednesday at 2:00 p.m, it was quickly determined that the majority of school meetings and activities

occurred on Wednesday at that time. Specifically the Student Council and math teams meet then, posing a conflict. The club advisors believed that many of the students involved in both of those would have attended the Science and Technology club had they not already had a previous commitment. By tailoring the schedules of the WPI group around those of the WPS students, a club with better and more consistent turnout could be created. This would be mutually beneficial by providing a more personal atmosphere between the two groups, resulting in better communication as well as a better overall experience.

1.6 What We Hoped To Achieve

The purpose of the Club project was to encourage the members of our club to become interested in science and technology and consider these fields as potential career paths after high school. While the encouragement was general, moving toward gender equality in these fields was the hope of the sponsors and participants. With the majority of our club members being sophomores or juniors, the thought of college selection and admissions looms over them. Having been in that position only a few years ago, we know that it is very intimidating that a choice will have to be made shortly that can potentially dictate one's path in life. One thing that is often overlooked is the importance of opinions and information conveyed by individuals who are only a few years their senior. These are individuals who know how they are feeling and can help the club members face their fears, focus and make a better informed choice if they are considering a technical career. It does not have to be a final choice, as one should keep options open. It is okay to have doubts, not be sure and just try something. The club needs to be a safe place to try this idea on for size and talk to people starting out towards such a career themselves.

One of the club advisors said that any chance her students are able to get away from the high school for a day and visit a college she feels is an extremely valuable experience. In her opinion, not enough of them entertain thoughts of going to college, and if they do they are ill informed as to the whole process. With some of the local Worcester colleges often taking a chance on some of the locally graduating high school students who otherwise would not be able to

financially afford college, it is important that the students realize the nature of the opportunity being offered to them.

One of the goals of the Doherty team last year was to address the gender imbalance between males and females in the science and technology disciplines. With last year's North high team not being able to gather a consistent group of students across several meetings, the North team went into this year's project with little idea as to what to expect gender wise. At Doherty we had some prior experience and we hoped to create an atmosphere that is as friendly and inviting for females as for males. The prior Dorchik and Duncan team had attracted a group consisting of 50% females at Doherty despite a four to one gender imbalance in ETA. They credited Kathy Kambosos with that success in mobilizing the ETA females. However, better response from ETA students would mean more males as well. The reach of the club has to go beyond the ETA to produce a gender balanced club membership.

We also hoped to shed some light on the best way to go about communicating information regarding the future and technical careers to the students. Whereas many do not think about college and approach the process with little idea of what they want to do, others do not even entertain thoughts of college because of concerns that it is too hard to do and costs too much. By providing information early in high school or even provide help with college application process for those members who are juniors and seniors, we hope to prepare the students to make better decisions when the time comes. The sort of information which the aspirations survey gathered on what the student concerns

are, is not only useful for our purposes, but to the guidance counselors at the respective high schools as well. Even the WPI admissions office would benefit from knowing if finances, grades or standardized test scores are the greatest looming obstacle to Worcester students aspiring to go to college.

The main theme of last year's team that came to North High for one presentation also focused on space elevator and the "Space Race" type projects taking place at WPI. The club advisors, as well as the students experienced dissatisfaction with this sort of approach to science and technology, feeling that it was over their heads conceptually. However according to Keithe Baggett the presentation on careers in space that was designed for high school students worked well. Not wanting to eliminate any students from becoming potential members of our club, per recommendation of the advisors, next year the North High team should deal with as little space related material as possible. Judging by the amount of space related material pushed at North, there was a growing misconception amongst the North High student's population that most WPI students are space enthusiasts. It is hoped that the club meetings will be based around more practical and "down to earth" subjects for a year or two to dispel this misconception.

It is also hoped that the clubs will provide a source of guidance for the members of our club with regards to what high school classes students should take to better prepare themselves for college. Dorchik and Duncan started with this goal and were told to start a club instead. Now the club members are making it clear that they want that and the original "college coaching" project

concept was on the right track. It is unrealistic to believe that the high school guidance counselors can identify and help the students that are freshman and sophomores who have not even thought about college yet let alone started preparing for it. The counselors have neither the time nor the experience to do this. Having not yet considered how taking advanced classes and developing a solid work ethic may impact their chance at a successful college career, the students are not ready for the standard college admissions pitch either.

It is our hope that we can instill a good attitude toward academics and provide good advice to those who are willing to listen. This could range from convincing them not to back down from the challenge because they heard rumors that a certain class was hard and that they might not be successful in passing it to sharing tips on how crucial it is to develop a good relationship with their instructors. We think that the club can make a difference in this area of how to navigate high school and get into college. As role models and sources of information we are making ourselves available to the students, so those considering a technical major in college have us as a guide. We did it, so going to an engineering college cannot be too intimidating.

2. Planning and Implementation

2.1 Initial Planning

For the initial phase of our project we were focused on preparing ideas for activities and trying to convince professors to do demonstrations at the schools. Many of our weekly group meetings were based on bouncing different ideas off of each other for possible club meeting sessions and getting feedback from the other group members on how to either improve on the idea, keep it as is, or throw it out completely. The main area where we lacked support was in getting professors at WPI involved in the project.

Our team made contact with many professors initially and because of the slow start up of all of our clubs we did not keep in contact with the professors that agreed to do at least one meeting. We were too easily discouraged by a few early negative replies from professors on coming to the high schools for a presentation. The search for interesting and willing technical faculty members was set aside too soon, as we turned to deciding what we ourselves could do with the help of other WPI students. Our team should have just e-mailed whole departments or gone to meet with department heads in person for advice and leads when our own approach to favorite professors did not work out.

It was more important to have some activities run by WPI professors in the clubs than we thought at the time. Also the professors that were contacted needed to be re-contacted frequently as the schedule and situation changed to ensure that we could have actually do something off campus. With WPI's

professors assistance the clubs could have been even more substantial, credible, and exciting than they were. More professional help from the WPI faculty would have better supported the club and recruiting professional presenters should be one goal of the next round of the project.

2.2 Plan One

Our team's first approach to the clubs set up was that each two person group would create their own presentation to be done at their own school and then the team would travel around to all five schools with their personal presentation for the high school students. The problem with this concept was the scheduling of meeting and also the timing of each club's start. Because the meeting times were the same for most schools, traveling to another school other than your own would not allow you to also attend your own schools meeting.

After meeting the club members and advisor we could not have envisioned not being at our own school's meeting. Strong attachments with the students that were regulars developed rapidly. They came to meet with us, as role model engineering students, rather than for any specific activity. They became acclimated to our team as their club advisors and our team was adjusted (even catered) to them as students. If all ten of us were switching schools every week to give presentations at other schools, we do not think that bond our team made with the students would have been anywhere near as strong. The two of us also think that that connection was one of the most important elements to our team's success in influencing the members as role models. We knew them and cared about them, and they knew it. Also with the clubs at the different schools starting at different times it would have been difficult to schedule having a member of another team free of WPI commitments at the time our club met.

With all the teams meeting at the same time theoretically we could have circulated, but in practice it was asking the other team leaders to sacrifice the

relationships we developed. If only one person on the team goes, the people who designed the activity together aren't acting as a team. Clearly a better model is to have outsiders not "running" a club circulate, and let a team provide continuity at the site and run half of the sessions. They can put on demonstrations and run activates designed by another team and practice it with them back at WPI.

2.3 Plan Two

The second plan we had was to create a pool of ideas that the entire group could pull from, and this is the idea that we implemented with the schools. Many of the ideas that we created in our larger group meetings were used at many schools but the advisors at that club ran the activity or performed the experiment. Ideas such as the egg drop, LEGO project management, and chocolate asphalt were used by about three of the clubs. This worked well because we made standard information sheets that could be used to run the experiment and then with that simple one or two page sheet the experiment could be done with ease by any presenting team possessing technical background.

This approach made it easy for the groups to work from each other's ideas without needing to actually spend that much time planning another school's activity. Thus, the club leaders could focus on their own clubs. Overall this idea worked very well and in the future with a bigger pool of ideas, the groups would be able to organize many more meetings by quickly sharing ideas with each other. If anyone "circulates" it should be WPI engineering professor advisors for each IQP group. If there were five faculty advisors for each of five teams (each at one school) they could "do the rounds" and repeat a favorite activity of their own that worked for their own team at their school for other clubs as well as get to know more of the high school clubs' high school faculty advisors.

3. Implementation

3.1 Meeting A (01/31/07):

Our team set up a meeting with the advisor Kathy Kambosos of the Doherty high school club last year. This was our first time ever talking to Miss. Kambosos; however, both Liz Tomaszewski and John Wilkes had already had a face to face meeting with Kathy about the club. This meeting allowed us to share the ideas that we had for possible activities and find out Kathy's reaction to them before actually using them in the classroom. When all of our original ideas were shared with Kathy (see appendix), her overall feeling about our ideas was positive. We were pleased about being able to use many of them. One of the comments she made was that the meetings needed to be as "hands on" as possible to hold the interest of the students. Other points she made were to not have the robotics demonstration that was done last year if it was done by Worcester Academy high school students. Another comment made by Kathy was not to have a meeting about all the different types of engineering as the first meeting because that would be too much like a lecture and the "hands on" tone of the club should be established immediately.

Meeting times were also discussed as well as basic information about Doherty High School and the ETA as well. Kathy gave us a tour of the school and showed us her classroom where we would be having the meetings. She also showed us the wing of the school dedicated to the ETA which is the

Engineering and Technology Academy. This is the specialized school at Doherty High School which is devoted to preparing students interested in pursuing a career in engineering or technology for college. These students have a heavier load of science and technology based classes.

The presence of this specialized school at Doherty led Kathy to tell us to be prepared for a relatively large turnout at our meetings compared to the other high schools in Worcester. The students attending would be highly interested in meeting engineering majors from college. We settled on having our meetings on every Wednesday starting the next week (02/07/07). Our first meeting would be an introduction at which we would also discuss all of our prospective meeting ideas with the students involved to get their feeling on what they would like to get out of the club. Kathy said she was looking forward to getting the club started and couldn't wait until the first meeting. Kathy said she would make announcements and raise awareness in her classes as well as have announcements made over the PA when announcements were made to the whole school. At this point we were ready to begin the next week. No survey or publicity campaign was considered necessary to find a pool of 20-30 students interested in considering the possibility of a technical career.

3.2 Meeting 1 (02/07/07):

Objective:

The day of the first meeting of the club we received an e-mail from Kathy Kambosos in the morning telling us to expect thirty students that afternoon. In this meeting we planned to introduce all the possible meeting ideas that we had for the club and get them “ranked” and also perform an egg drop experiment. (The handout for the egg drop experiment is in the appendix) We planned on spending half the meeting on the introductions and half on the activity. The plan was to have a two part competitive experiment so that the students would be encouraged to come back next week and also to not have introductions dominate the first meeting.

Turnout:

Though warned, we were still very surprised when we saw a full classroom of students. We had a total of thirty two students at the first meeting and three of them were not involved in the ETA program at Doherty. The most common grade level was freshman while sophomores and juniors were also represented. Fourteen of the students in the group were females. This made the group about forty four percent female, and thus more “female” than ETA which was usually about twenty five percent female.

Actions and Reactions:

The first order of business was the introduction of ourselves and the club. We then moved on to the explanation of the possible meeting ideas we had

gathered from the larger groups and got reactions from the students in the club. They responded well to all of the ideas for club meetings and also expressed interest in the areas of aerospace and automotive engineering.

At this point the first experiment was introduced. The egg drop was the first activity we did with the students. The aforementioned handout was passed out to all the students and we then told them to arrange themselves into small groups to begin work on their designs. Before they started, the objective and theory behind the experiment was explained and then we let the students work in groups of three to five people to create a design to protect the egg.

During the next twenty minutes the two of us walked around the room to talk to the student teams about their designs and offered suggestions. The students were pretty involved and right away had good ideas for the experiment. After the twenty minutes of private consultations between groups we brought the meeting to a close by asking groups to share their ideas with the class. However they were very reluctant to divulge anything about their ideas because this was a competition for a prize. We did get students to talk about materials they were going to use for their design and then adjourned the meeting.

Meeting 1 Conclusion:

Overall this meeting was a success. The introductions went well and it was clear that all the ideas we had for meetings were on the right track and the group had endorsed our setting up as many as we could. The students seemed to be very interested in the egg drop experiment and were excited to build and

test their ideas next week. We were also eager to see what the students came up with for their egg drop designs.

3.3 Meeting 2 (02-28-2007):

Objective:

The objective of this meeting was to finish the egg drop experiment and award a prize to the winner. Starting a new experiment on the chocolate asphalt idea was also on the agenda. In order to make good use of cooling time we started off by making the chocolate asphalt. We handed out various candies that would be used as aggregate in the asphalt and also gave them melted chocolate to use as the liquid asphalt. The students made their asphalt and we set it aside so that it could set while we tested the egg drops made by the students and give the prize to the best egg protection device.

Turnout:

We once again arrived to a full room of students. This time we had twenty six students at the meeting and still had three students not from the ETA program. The most common grade level was again freshman while sophomores and juniors were also represented. The freshman class was represented by eighteen students in the club while the sophomores and juniors in combination constituted eight in attendance. Ten of the students in the group were females. This made the group about thirty eight percent female at this meeting.

Results:

The making of the chocolate asphalt went well. All the students participated and listened to us while we were explaining the facts about actual asphalt. They also seemed pretty interested and surprised by some of the facts

that they learned that day about the real asphalt that paves the streets we drive on. Then when we moved on to the egg drop and everyone was very excited to see who would win. We gave all of the students eggs to put inside of their egg drop devices and then went to the first test. The first test was to drop the device from a height of five feet and have the egg survive the fall. All seven of the groups egg drops survived the fall and moved on to the next round. The next test was to survive a fall from the height of the ceiling (9ft). Again all seven of the egg drops survived and moved to the next round. Then the next round was much harder. In this round the egg drops at the wall. For this test we lost four of the egg protection devices failed and three survived. So those three egg drops moved on to the last test of getting spiked against the ground. Only one device survived this test, with an intact egg and this group was named champion. We gave the four person team all ten dollar gift certificates to Best Buy. At this time we rehashed the design process for the egg drop and talked about everyone's designs. We talked about what could have been done better and different materials that could have been used to get them all to survive the test. Overall the students did a great job with the experiment and showed a lot of interest overall in what we were trying to teach them. The students were on break the next week so we set the next meeting for February the twenty eighth.

Meeting 2 Conclusions:

The students seemed to get a lot out of both experiments. The asphalt experiment provided them some knowledge of civil engineering and the make up of the road paving materials. The egg drop experiment showed them a lot about

the general design process of engineers and how to design something from a simple set of requirements. The students were still very excited about the club and looking forward to the next meeting, as it was living up to the expectation that we do things as much as talk about them.

3.4 Meeting 3 (03-14-2007):

Objectives:

This meeting was grounded more in physics than any of the engineering sciences. We started off with a lecture on the physics of a rollercoaster, including physical principles such as potential and kinetic energy and conservation of energy. Also reviewed were topics such as g force and centripetal acceleration. We went over a rollercoaster that we had designed with a loop and a hump on it and showed them the values of velocities and g forces at critical points that must be taken into consideration when building a rollercoaster. Then we let the students take some time to design their own rollercoaster and told them to keep the g forces within certain limits. We also challenged them to push the limits of g force in their rollercoaster within those limits to make it fun for the riders.

Turnout:

Once again we managed to attract over twenty students. This time we had twenty one students and still had the three non ETA members coming to the club meeting. The most common grade level was again freshman, but sophomores and juniors were still showing up. There were fourteen freshmen club members in attendance twice the number of the seven sophomores and juniors. Eight of the students were females this week. This made the group about thirty eight percent female once again.

Results:

Overall the meeting went very well. Initially the physics concepts were too advanced for most students because they were mostly freshman and had not been exposed to any physics before. After a second explanation of the concepts some of the students started to catch on and started working on their designs. We started walking around the room to help students individually try to figure out how to begin thinking about a rollercoaster. There were about seven groups of three students working on the roller coaster and three of them were trying hard to design a working rollercoaster using the concepts discussed. Some of the other groups did not seem as interested and we had to push them to try an idea out while helping them apply the concepts, but in the end they did figure out a simple rollercoaster loop with some help. The meeting was not as hands on and exciting as the previous meeting, so it was definitely not the favorite of the group. However they all did learn something about physics during this meeting.

Meeting 3 Conclusions:

This was definitely not the club's favorite meeting because it was more conceptual and abstract than they were used to, not just trial and error. The meeting focused more on math and science than on engineering concepts; however, the idea of keeping the g forces within certain limits is the engineering portion of the experiment. Out of the twenty one students in the meeting we would say that only half really understood the lab and finished their rollercoaster design. If a physics meeting like this was to be done again it would have to include a portion that involved building a model and a competition or just taking

the math that was done and applying it to test the idea with a computer model that offered a visual demonstration. Something that could have been done was applying the same equations used to a projectile motion problem where the students would be able to show their results by rolling a ball off a ledge and showing where it would land through the use of physics. The meeting was a success for the half of the students that did get the concepts and designed their rollercoaster completely, but if the club is going to attract mostly freshmen there can't be too many meetings like this one. The idea seemed promising, but in practice it was too open ended.

3.5 Meeting 4 (03-22-2007):

Objective:

For this meeting we arranged for Tiana Carasquillo from the WPI admissions department to come to Doherty and give a presentation on the different types of engineering sciences. She was also going to talk about what it takes to get into a technical school and other things they should be doing outside of their classes to make themselves more marketable to a technical school.

Turnout:

This was by far the smallest turnout for our meetings; we had a total of thirteen students here for this meeting. I think this was because the sophomore and juniors returning students had already seen this presentation. Also some of the girls had already seen the admissions presentation at WPI during the FACES program. Another reason why turnout was down might have been that this meeting was not on our normal meeting day. We had this meeting on Thursday instead of Wednesday so that Tiana could be there. A lot of the students were not aware of this change or had other club or sport activities they could not miss on Thursday. The breakdown of students for this meeting was eight freshmen and five upper classmen. There were six girls at this meeting making the percentage forty six percent female.

Results:

During the meeting Tiana started off with a general talk about WPI and the opportunities that WPI offers. Then she moved on to the different types of

engineering trying to keep the students as involved as possible by asking them what the different types of engineers do and what kind of industries they work in. The students were fairly involved in answering the questions that Tiana asked and surprisingly showed a great knowledge of the different types of engineering fields. Once all of the engineering fields were discussed Tiana handed out 3-D WPI puzzles to all the students and information sheets and sheets to join the WPI mailing list. The students handed in their mailing list sheets and Tiana picked one of them out for a T shirt raffle. So the students were happy to get a puzzle and were pretty distracted by it for the rest of the meeting. Tiana tried to continue talking about what the students need to take for classes to get into a technical school and also extra-curricular activities that would be helpful in making them look better on their college applications, but it is not clear how much of that got through to the eight freshmen.

Meeting 4 Conclusions:

The meeting was probably a success because they did share and thus learn about the different types of engineering and were also given a basic knowledge of WPI that they did not have before. The students were pretty distracted, though, once they were given the puzzles by Tiana. This proved even more that the students need hands on activities to stay involved in the class because they have already been through a whole day of classes and do not want to be lectured again for an extended period of time. The students did get something out of the meeting as they heard a college admissions person tell

them what mattered while there was still time to use that information. For us that is the important part.

3.6 Meeting 5 (03-28-2007):

Objectives:

In this meeting the two of us wanted to touch on an aspect of engineering that people in all fields have to master. We decided to focus on the project management portion of a project as opposed to the actual design engineering. The majority of people will assume that an engineer sits behind a desk and works out calculations all day. There is actually more to it than just jumping into the design process and this is what the two of us wanted to convey in this activity. In this specific exercise we are working on a civil engineering based topic but all types of engineering have to go through similar processes prior to design.

The overall experiment was to see how the students would do when we gave them specific requirements for a project. The students were separated into groups of four to five students which are something one likes to do to build teamwork skills. Forming teams in the meetings maximizes the interaction level, and it also fosters a competitive atmosphere. Each group received a certain number of Legos that we divided out evenly before arriving at the school. The Legos each had a specific point value that represented money. The larger the Lego the more expensive it would be to put in your building. The students were required to build a tower of any shape or size and they would have twenty-five minutes to complete it. After completion of the tower we would put it through certain tests to finally arrive at a winner. The towers would be tested on their height, the amount of money they spent and finally be put to a series of wind

tests. The strongest, tallest, and least expensive building would yield the winning team of this contest.

Turnout:

Attendance was about twenty for the Lego experiment meeting. We had nineteen students arrive at the beginning and some more shuffled in and out as they had prior engagements. Of the nineteen students, seven of them were female (37%). ETA attendance continued to be high with seventeen of the club members at this meeting being in the Engineering and Technology Academy. We hoped to bring in more students from outside ETA for this meeting by letting them know that the meeting involved playing with Legos. This did excite the people who came, and kept them intrigued throughout the experiment, but they were mostly ETA students. Overall the attendance during this meeting (which was around the average) is what pleased us. We had feared that interest was waning; now it seemed that the hands on club events were retaining the interest of the bulk of the original groups.

Results:

At the end of the contest the students put their model towers through the testing phase. Most of the students did not use any of the management skills we tried to teach while building their towers. Indeed, Some of the groups were not able to grasp the teamwork concept at all. They just built multiple towers and competed within their group. This is not how we had wanted them to approach the project but were glad they did the project so that we could point out the advantage of good management methods we'd presented since the stronger

groups were clearly those which had worked together. Since most groups focused more on the strength aspect as opposed to the cost of their building. Most groups did not budget their pieces and ended up creating a building that was much too expensive so their design lost points. Some otherwise good groups, mostly the groups that consisted of females, focused on the elegance and beauty of their building and a few of these completely disregarded the functional requirements that they were suppose to meet. Making tradeoffs to reach an optimal balance was not coming easily to the mostly ETA students in their event.

We put the towers through strenuous tests until there was only one still standing. The smallest building of them all (that most people would not consider a tower at all) was the ultimate winner of the contest in terms of strength. A tiny structure that consisted of three Legos was the best tower constructed. It was cheap to build and it withstood all the wind tests we put it through. The other towers were much taller, but because they made them all much too wide they lost out in the financial aspect of the project. This clever group noticed that this would be the case and did the exact opposite of what a “tower” meant to most people. This counter intuitive approach gave them an overall victory given the criteria we had specified.

Meeting 5 Conclusions:

From our perspective this was the most productive meeting of all and most relevant to what Doherty was currently trying to convey to their students. Kathy was very interested in this experiment because of the multileveled lessons that it

was teaching the students while they had fun competing. They were learning lessons that they could not only use in design classrooms to come but they were learning cost effective concepts that would be helpful in their everyday lives. The methods of time management, developing multiple strategies, and teamwork were all coming together in this meeting. At the end of the meeting not only did they have multiple comments and questions but Kathy's interest in observing sparked many questions and comments of her own to get them thinking more deeply about what had happened. This was the most important meeting of the club because of the high information yield the students were able to obtain from it. Kathy personally underscored the importance of what we were conveying and, stressed that it was something that had to be taught in a similar fashion in all the clubs of the Worcester Public Schools. We had found a focus that was educational, yet was more suitable to a club than a classroom environment.

3.7 Meeting 6 (04/04/2007):

Objectives:

In this meeting we were attempting to accomplish something that last year's group was not able to accomplish. Duncan and Dorchik came up with the idea of having a WPI field trip during which the students could visit WPI campus and experience some the campus life. The reason they did not have the field trip last year was due to the time constraints of the project and they just could not fit it in given how close to the end of the school year they got permission to start. A field trip that involves high school students takes a lot of preparation and planning and they did not have the time and resources for it to happen. The idea of a field trip was perfect and we knew that it was a goal for this year. Ironically we had the time, but struggled with the resource generation since WPI approved a budget for the 2005 – 2006 team that included an honorarium for the club high school advisor but, disapproved ours for 2006 – 2007.

We suspect that since cost of five groups was significantly greater it attracted attention this year. Still we sold the Projects Office on the idea that a successful field trip would be good for WPI and got one bus covered, while losing all the other requested budget items and being warned off of the idea that WPI should pay WPS teachers to do after hours work just because of a union contract.

There was agreement that a successful field trip give them a glimpse of the WPI lifestyle mixed with new knowledge of certain topics. So, as a compromise, the Projects Office covered the cost of the bus.

We felt it would be very important to the purpose and goals of this club to show the students where we come from and what our life (and their possible future life) is all about. Every local high school student interested in engineering should visit and experience a college with a technical culture. In this area WPI is the best example we hoped to show them some projects done by other IQP groups and give them access into some laboratories where they could get a sense of what studying engineering would be like.

By combining forces with other IQP groups we were able to get them invited to a space flight oriented set up a space conference already in the planning stages that the students would be able to attend after a tour while still on campus. This space conference would consist of about six IQP groups presenting their projects on space related topics ranging from likely breakthroughs in space technology to building a moon base. The high school students would make up the majority of the audience for the presentations (though college students would be in attendance) so the student pugwash organizers and presenters would have to attempt to cater to the high school audience. The organizers seemed to understand, but in the end we learned that we had delegated too much of the planning to them. There was a session on high school student attitudes toward space, and another on emerging careers in the field in the groups of sessions planned—but alas, they were not scheduled to be given while our students were there. The one's they did see were not as good a fit on the whole. However, what we expected them to see, should have increased their knowledge about space and what the future may hold for them.

With a solid WPI tour and a well prepared space conference we hoped that the students would leave with a new outlook on engineering and WPI.

Turnout:

In order for it to work we needed a lot of help from our WPI advisors because we were not experienced in the entire process of organizing a field trip from a public school. With their help we were able to get it organized and paid for. The agenda for the field trip was going to be tough to plan because of the many different schedules we had to work around. Luckily the individual clubs were very successful in convincing their schools that this trip was a good idea. We were able to get four out of five school clubs to attend our field trip and the South High groups might have been able to make it in a different year. They asked to be invited next time as it was accepted as a good idea. In the end approximately sixty students from all four high schools went to WPI on the same day.

Two busses went around to the individual schools and picked up the students who were attending the field trip. In Doherty High School's case our advisors Kathy Kambosos did not feel that it was necessary to allow all the students who had attended meetings to come on the field trip. She made the decision as to who went on her own and chose the students she thought deserved it the most. She chose twenty of her students that she thought had expressed the most interest in the club and that most earned the right to be there. Other schools may or may not have done their selection process this way.

All in all the attendance level was high and this made the field trip a success in its own right. The idea of leaving school for the day was understandably popular.

Results:

The field trip was intended to last for nearly the complete school day (9:30-1:30) so we were going to have to make sure they were busy for the entire time they were on campus. The space conference was scheduled from eleven o'clock to three o'clock so they would be there for the first half of the program. The time before the conference was going to be a tour of the WPI campus. Originally this tour was going to be run by the WPI club leaders and the other IQP group members, but we did not have the day off. Hence, most of us had classes that we felt obligated to attend during part of this time. Luckily WPI admissions had a team of trained tour guides and was willing to take on the responsibility as they thought that they would be able to give a much more effective tour anyway. Although they were not able to get the students into any of the laboratories, we still thought they did a good job in showing the rest of the campus, and they did a great job on an initial assembly and orientation presentation before the tour. There was even a professional videotape.

The space team was able to reach an agreement with WPI Admissions that gave us a financial boost to cover the students' lunches. They were willing to pay for pizza or to let the high school students go through the cafeteria line. The space group wanted a buffet table so Admissions paid part of that (the same cost as pizza) and Pugwash paid for the rest using its one thousand dollar budget to pay for the rest. In return for their help the Admissions staff got to talk

to the students and give them a short presentation on how to get into WPI before the tour. This was a good way for the students to learn what they needed to know and do in a few years.

The lunch was the final challenge that we faced. We originally thought that box lunches would be the best and easiest way to go, but the Pugwash/space students did not agree with this because they wanted it to be more professional and wanted it to be a buffet style lunch. Since they were paying they had the last say in the matter. The food service set up a buffet lunch and pugwash placed the lunch time in the middle of the conference during the keynote speaker's talk. The result was chaos, since the eighty people present couldn't rapidly grab lunch, return to their seats, hear the talk and get to the busses in the forty five minutes.

It took far too long to assemble sandwiches in a long line. It was worth noting that the buffet table idea was devised when the conference was in a room with a door in the back and a place for the buffet table in the back. Then groups of ten to twenty people at a time could have gone to get food without disturbing the talk. Due to a schedule issue the conference was moved to a room with a door in the front and no place for the buffet table in the room, so people had to go in and out in the front of the speaker. The club advisors were also concerned about getting their students fed and on the bus in time, so they let them all go to the buffet table at once causing more problems of congestion. They did not see why there was a complicating dinner speaker. Things went pretty smoothly up until the conference but we still consider the field trip to have been a success,

despite the short memory of the Pugwash organizers about the high school hubbub surrounding lunch and buses.

Meeting 6 Conclusions:

Although the field trip was a success there are many suggestions and recommendations that we would like to make for future reference. The first thing that needs to be done is to find the right venue and find it early to make sure that it is not already booked. The room Pugwash wanted originally was booked for part of the conference time so we were not able to get the exact set up that was necessary to run a buffet during the talk. This caused some problems with lunch because we had to have people leave to get their food instead of having them get food during the presentations. This created issues with time which would become a real problem, but with box lunches this could have been handled. With a buffet it couldn't.

Keeping to the schedule that we set was the biggest problem that we had during the conference. The admissions talk was done on time and the tour was completed for most groups on time. One group was slowed up on their tour and got to the conference late. This started a series of time problems that resulted in some difficulties. The conference started behind schedule by ten minutes, added with some groups using too much time, ended up putting us about twenty-five minutes behind schedule getting to lunch and the keynote speaker. This caused us to rush lunch because we wanted to make sure we got all the speakers in. The buffet lunch was very slow moving which forced us to send students who had not yet eaten back to their seats for the speaker and call them down later

during the talk. We finally got everything settled and everyone received their food so it ended up working out. The main speaker was not able to finish before the students had to leave and catch their bus, and he had been flown in from Florida to speak to them, so that was unfortunate. He should have spoken first. The first group to speak to the students was disappointing, but the keynote speaker was great.

As far as the speakers went, some were not as interesting as we had hoped. We had discussed which speakers to schedule when our students were going to be attending. This was not how things worked out due to the fact that some of the student speakers had classes and prior obligations during this time. This forced the moderator to allow other groups to present that did not have the most intriguing of topics for our audience. Some of the groups did do very well though and we were glad that the high school students were able to see some good college projects.

The biggest disappointment was the fact that the best speaker was saved for last. He gave a great presentation that all the students were extremely interested in. The problem was that there was only enough time for him to speak for ten minutes and then the students were forced to leave so they missed most of the talk. We spoke with the students after and they had wished they could have stayed for the entire presentation, but the busses had to leave on schedule no matter what.

A field trip for high school students is very difficult to plan because there are so many different factors that you have to take into consideration. We

delegated too much of the planning to the space groups and despite a lot of work we also faced many problems. If there are field trips in the future, it is important to pay attention to logistical details, such as being present in case the first group arrives early, and lunch and speaker order. These details really matter. This is the best way to have everything go smoothly, learn from the mistakes of others.

Overall it was a successful trip and this we are very proud of, this “pilot” study of the value of a field trip. With a lot of help from our WPI advisors we were able to make everything work and we were able to give the high school students a lot of useful knowledge. However, the speakers should have to “dry run” in advance, to be sure they are ready and speaking at the right level for the audience. If not, they don’t get a “prime time” slot, and should be scheduled after the high school students leave. Also, a one topic conference, all space, is not ideal. Duncan and Dorchick had a better idea for what the field trip should be like, but we could not get enough faculty and department support to get into the labs and hold to the kind of events they had in mind. They wanted to showcase different fields. That would have been better.

3.8 Meeting 7 (04/11/07):

Objectives:

This was the final club meeting so we wanted to do something special for the group because they were so appreciative of our efforts. A pizza party celebration was the focus of this last meeting, but we also wanted feedback on the six prior meetings. Feedback from all the group members and their advisor Kathy Kambosos, meant they had to be attracted to the meeting, hence the party.

Turnout:

Unfortunately, the pizza took longer to prepare than the restaurant had said even though it was ordered three hours in advance, and this made us ten minutes late for the meeting. By then Kathy Kambosos thought we were not coming and told the students that it was okay for them to leave. So the majority of the students had left when we arrived. The remaining students got to have twice as much pizza, but we ended up with feedback from only ten students and Kathy Kambosos rather than twenty five students. It was not a total disaster, but the pizza we had hoped would increase the turnout and feedback ended up reducing our feedback.

Results:

This meeting had a more laidback atmosphere a usual and more non-club topics were discussed. Still there was a short discussion with the students on how they felt about the club. A few of these students were also in the club last

year and they had positive comments about this year's club as having made some improvements. They felt that the lessons were just as informative but a bit more fun so it kept their interest better. They also let us know which meetings they enjoyed more than others. The students thought that the Lego experiment and the chocolate asphalt were the most interesting. The other meetings were also very informative but were not as much fun as these two meetings.

After the party we had a talk with Kathy to get her feedback on the club this year. She informed us that our being male athletes had helped a lot in terms of keeping some of the male students in the club. There were a group of five to six male students that were not too excited about coming to the club every week and drifted away last year. In the past Kathy Kambosos had felt the need to twist their arms a bit to keep them attending. This year they came to the meetings without coaxing through their own free will due to having "connected" with us. Also Kathy Kambosos felt that because we were not the "stereotypical" engineering students it made it easier for the students to get along with us and see themselves as engineers.

At the end of the meeting Kathy Kamobosos made it clear to us that we did a great job and she was determined that this club should be continued in the future. Something important was happening, and the club was very effective in teaching indirectly about the larger issues where experience is more important than information. She wanted us to do what we could do to be sure this "experiment" became a continuing policy initiative for both WPI and WPS.

Clearly the harder part was going to be on the WPI side. We needed more club project advisors from the WPI faculty.

Meeting 7 Conclusions:

Although the main purpose of this final meeting was to say our good byes and thank the students for everything, we ended up taking away much more than that. The opportunity to look back on shared events made this one of the more important meetings with the group because it became a time to actually talk casually and get candid feedback. We received enough positive comments about the club to convince us that it was very successful. Yet, we also heard things that would help us improve the club substantially in the future. Not only did we get good feedback from a few people who were the most committed core group of the club, but it allowed us to get more personal with the students who got the most out of it. The casual roaming talk let us find out what they were thinking of doing in the future. Dreams and aspirations were emerging in these more casual meetings because they got to know, trust, and identify with us. The first six meetings exposed the student to many new things but it was us who learned the most from this seventh and final meeting.

4. Conclusions

4.1 Recommendations

This year the future scientist and technologist club at Doherty High School was more developed and more organized than last year due to the recommendations that they gave to us. Dorchik and Duncan let us know what worked and what did not work and this gave us something to build from for this year. The main recommendation we can give is to start as soon as possible. We started in B term, and some people were already involved in activities and couldn't choose this over other commitments at that point. A start in "A term" would be much better because it does take a while to get everything started. It is suggested to aim for late September with the club announcement three weeks earlier. There are a lot of things that need to be done to keep busy for a month. Starting earlier is good if you can have an organized approach ready in time. With more organization the group will be much more effective and much more successful as it can start when the other clubs start and be as good as it was this year.

One of the more important meetings last year, as I stated earlier, was the field trip the students took to WPI. A field trip is something that must be repeated next year, but the funding and logistics are daunting. WPI may not be the location that the group chooses to visit next year, but a similar field trip must be organized or the team needs to provide a WPI tour after they get to know the student audience. I recommend going to WPI because it has already been done,

but not the way Duncan and Dorchik wanted to do it. This will make it much easier for the next team to get done with a successful outcome if they have technical faculty advisors who can get them into the labs to see students doing MQP's in them. It won't be easy and will take a lot more work than the other meetings but it should be attempted and assessed. Even our flawed meeting was very promising as a way to reach the students. It is advisable to read comments for meeting 6 before planning another WPI field trip.

As far as the other meetings go, the group should definitely try to find some new ideas that will keep the returning students interested. We only had a few students that were in the club last year but they enjoyed the fact that we did not repeat what happened the prior year in any of the meetings. Actually we could have if we allowed them to judge or assist in running the event. This makes it a little more difficult but it will definitely be worth doing. It may help that there has been two years at Doherty already and that some ideas from the first year could be repeated or adapted for next year. Next year the things to do with "new" students are clear, the field trip can be redone better and our relative neglect of science in favor of engineering also calls for greater balance. If there are science majors, athletes, and women in the WPI club project next year take advantage of your strengths and try to involve the technical faculty.

The most important thing to think of when going through different ideas for meetings is what will be the most interesting to the students. This may seem like an obvious factor, but few classes do this and some of the Space Project presentations wanted to make a point rather than be clear and accessible. By

coming to the realization that these are students in high school who are not signing up for a class. Understanding where they are academically and where they need to go will assist in making the clubs meeting successful. Everyone who has been through high school knows what holds the interest of the people and what puts most people to sleep. These are not average high school students but they still want to be entertained and have active fun groups. The meetings must be stimulating and still maintain their educational value. The ideal meeting should be “hands on” with all the students involved. It cannot become a classroom atmosphere. The students have been sitting in the classroom all day and the last thing they want is to be lectured even more. They are young and full of energy and this must be considered in running a club. If their interest is maintained you will maintain good attendance, and word of mouth advertising and anticipation will generate more interest. The goal, especially if they have some input into the agenda, is to live up to fairly high expectations. They are expecting you to be pretty good if you go to WPI.

4.2 Overall Conclusion:

This project took a lot of work from multiple sources but as coordinators we claim that the final outcome was a success. Last year's team of Duncan and Dorckik worked hard to establish an official club at Doherty High School. We think there should be future politician, lawyer, nurse, and business clubs too, but for many of these professional careers, one makes the decision to go to professional school for an MBA, law degree or medical degree while in college getting a BA. Art school, Music Conservatory and engineering schools are different. The professional degree is also the college major. Hence for engineering a club of this type for high school students is even more important than it would be in these other fields. A club for people considering political careers should be considered next as there is another area in which it is good to learn by doing. Also, volunteering to help with a political campaign is possible for a high school student. However, natural interest in science and engineering peaks in eighth and ninth grade and those who develop it and want to pursue it need the kind of support a club offers to make a career decision in twelfth grade. We had mostly ninth graders in this club, with the ETA program students draw upon.

Kathy Kambosos said it best when she spoke of the need to keep the club concept alive and develop it further. It is very important for the high school students to be exposed to this type of activity and have a chance to interact with people doing something they might want to do too, in this case going to an engineering college. WPI is project oriented and engineers rarely work alone.

Thus active and cooperative learning is much more common than it is in the typical high school classroom. Information that may benefit them in their search for a career can be conveyed informally and naturally without their having to ask the right question in a formal counseling session.

The students seemed to take a lot away from every meeting and be getting a sense of what engineering do and how they think. This is what gives the program its importance. The goal of this program is to help the students get exposed to possibilities and learn what their interests are. They get to try on this career for size in a nonthreatening way. Since they happen to be interested in science and engineering, we have some influence. As WPI students we are potential role models and sources of practical information. Since we are close to their age it is easy for us to teach them what we know and show them what it takes to get in to this kind of college.

They need to explore options at this age, so first it helps to know what their options in life are as a technologist. Even at ETA they do not get the information that they need to consider the next step. ETA is a program that consists of a sequence of courses. It helps to make a paper case for college admission in the sense of the right classes and hopefully good grades. However, for a good essay and interview it helps to have done things like what you will be asked to do in projects. If it was up to us we would have other schools that specialize in different types of career paths come in and start their own clubs. We just think the importance of this club extends beyond just one or two years. It is something that should be continued and hope that the future of this program

reaches its full potential. For us success is not recruiting more engineers, or even more female engineers, but in making it possible for students to consider their options free of stereotypes and with access to reliable information. They should have a person pursuing a technical career to talk to openly. So, at Doherty we were ready to try things with access to a special pool of students, since Doherty was the home of ETA, and Kathy Kambosos was back in the classroom after a year of being a part time ETA administrator.

The other clubs are about a year behind in club development, but one other club, the one at North High had the same advantage we had of knowing who their advisor was on day one. Prior team that never got into the school did that much for them. Their advisor was a WPI graduate and he was almost as committed to the idea as Kathy Kambosos, but he was a chemistry teacher, not an engineer, and did not have a pool of ETA students to start with. The academy at North High is devoted to careers in the Health and Medical careers, not engineering and technology. Our predecessors at Doherty and North are the ones that struggled to get official approval at the Worcester Public Schools and evolved the idea from a career advice on how to get into college (a resource for the guidance department) into an after school club. This took so long that they barely got to run a full program at Doherty and had to run a compressed experiment and give up on their field trip plans. It completely killed the North High club effort.

As we compare notes with the club organizers at the other schools it is evident that the most important boost Duncan and Dorchik gave us was finding a

WPS advisor who really wanted to see the project succeed. Kathy Kambosos had wanted to do something like this for years but did not have a way to do it for “free” until Duncan and Dorchik started the club last year. She helped some of the other teams too, by approaching colleagues at other high schools to advise clubs, but it was evident that she wanted to role model and pioneer the club idea, hence she was willing to take risks, advise, learn and give constructive feedback. Hence, we found ourselves in the point position of a grass roots movement to demonstrate the value of this idea to more administrators at both WPI and the Worcester Public School system. She was our ally in this effort or maybe we were her allies.

In the end we learned that this kind of club is very important for high school students and should be continued. WPI should definitely be able to support this club as an ongoing joint operation between WPI and WPS. Programs like this should also be started all over the country to influence high school students interested in science and technology. The project based group meetings might also be incorporated into the ETA program to allow for the students to have more fun while learning. This would create more desire to do well in classes if competitive group activities were used in class to make learning more fun. Overall if the club is continued it will fill a void in the WPS system that will help students with interest in science and technology to pursue their interests.

If it can play so valuable a role where a unit like ETA already exists we suspect it could be even more valuable in a school like North, where that academy is in another field.

References

- Custudio, Evan, Brian Marsland and James Scully "Worcester High Schools Career Aspiration Replication Study" IQP, Worcester Polytechnic Institute, December 8, 2006
- Duncan, Matthew, and Brian Dorchik. A Future Scientists and Engineers Club for Doherty High School: a Pilot Project. Worcester Polytechnic Institute. Worcester, 2006.
- Handler, Laura and Patrick Hogan "Gender-Based Comparative Study of Public High School Students" IQP, Worcester Polytechnic Institute, March 7, 2005
- Hwang, Jason, and Tri Lai. North High Coaching: Coaching Students and Analyzing Urban Education. Worcester Polytechnic Institute. Worcester, 2006.
- Ngo, Alan and Souza Timothy. North High School: Science and Engineering Club. *Sections: (What We Hope To Achieve, Issues, and Sponsor)*. Worcester Polytechnic Institute. Worcester, 2007.
- Rizkalla, Nora, and Zachary Gautreau. Middle School Aspirations Study. Worcester Polytechnic Institute. Worcester, 2007.

APPENDIX A:

November 5, 2006

Kathy Kambosos
Doherty H.S.
299 Highland Street
Worcester, MA 01602

Dear Mrs. Kambosos,

I am writing this letter to introduce a team of ten students that have registered for the project offered by John Wilkes and Liz Tomaszewski to expand and improve on last years high school clubs project. This project would work off of the project that Brian Dorchik and Mathew Duncan set up last year, but we will now have a larger team setting up five teams of two students to send to each major Worcester High School. We would also like to start earlier to make more meeting times possible.

Our group consists of juniors in both mechanical and civil engineering. Most of us are also football players at WPI and involved in the fraternity system. We are looking forward to working with kids in the same place we were three or four years ago thinking about what we are going to do with our lives and considering engineering as a possible career. We would all like to share what we have learned at WPI to help these students potentially interested in engineering to pursue their goals and give them a better engineering knowledge base as they move towards college. We can share about the college culture and community life as well as the academics, but will not be trying to “sell” WPI per se. Still we want to make WPI resources available to the clubs.

As we develop our proposal we will want your perspective on how things went last year at Doherty. We have read Dorchik and Duncan’s report and it made us optimistic about what can be done this year.

We also want to know what you think about the idea of approaching the other schools about similar clubs. Would you be able to provide names of people at other Worcester high schools who can advise clubs and do you think the ETA should “sponsor” the clubs at other schools as an “outreach” program? We also want to talk to you about whether running the sophomore survey was valuable enough to do again maybe in a required science class.

I hope we can meet soon to discuss the club and how it will be moving forward this year. We are really excited to get the club going and start teaching kids some basic engineering.

Sincerely,

Chris Norton, Orry Cummings, Charles Fradella, George Chyoghly, Keegan Richey,
Matt Frasier, Nick Ambrosino, Alan Ngo, and Timothy Souza
ctnorton@wpi.edu

APPENDIX B:

Initial Group Proposal

Our intentions of this project this group is partaking in is to set up and run successfully various science and engineering programs in the several high schools in the Worcester and immediate surrounding area. Our preliminary idea was that these programs could be run as an after school extracurricular activity, where this group's members gave demonstrations as well as interactive lessons on concepts related to space, engineering, and any future concepts relating these two ideas. The initial schools that we wished to pursue these programs in but not limited to Doherty High School, North High, South High, and Burncoat. The group's decision was that with our desires being to contact several of the appropriate faculty members in as many possible establishments, a terrific beginning would be to be able to collaborate in some way with a person who both cares about the meaning behind these projects and also has the ability to contact possible faculty members in other schools. Our optimum goal in the end would be to have some sort of variance of the currently existing group called ETA, which would be in essence spread out amongst these other schools in order to either aid in already interested children, or to spark some sort of interest in these fields of engineering. We currently have data, albeit it somewhat outdated, on several other schools which confirms suspicions that there is an increased interest in high school students in this area in the fields of engineering and other related sciences. Our group's desire is to cultivate these interests in order to give these students a taste of what pursuing these concepts in a career would be like. An additional goal spoken of is to be able to create a significant increase in the percentage of young women participating in these hypothetical science programs; however this of course is a supplementary goal that will be spoken of once these

programs begin to actually materialize. We have decided that the first step in this project should not be contact Bert, but to rather attempt to contact faculty members in these other schools who may eventually be able to run these programs. Our reasoning behind this decision is that if these faculty members bring this idea to their supervisors in an organized manner as well as in a manner specific to their situation, our chances of these ideas taking form in one way or another increase dramatically.

Our group realizes how valuable you would be to the continuance of this project. You have a unique perspective in this project, in part due to your close interaction with the group as it acted last year. Your advice on what concepts you thought to be successful or worth pursuing further may be what separates this project from being a successful one or a failure. If we are eventually able to move these programs into other surrounding high schools, any possible contacts as to people who may be interested in heading these groups around Worcester. We would also love to hear your concerns and conclusions about the validity of the survey conducted last year, as well as if another should be given. Our group realizes you are going well out of your way in being a part of this project or providing any types of appropriate contacts, and we appreciate any sort of assistance you would like to provide in creating these projects. Thank you in advance for reading and considering our proposal.

APPENDIX C:

High Prospective Projects

- Chocolate Asphalt
- Lego Project Management
- Gears, Cams, and Linkages
- Teraforming Mars
- Computer Science with Professor Gennert
- Rehabilitation Engineering with Professor Ault
- Robotics Demonstration with Ken Stafford
- Space presentation field Trip
- Introduction to Engineering (Job's, salaries, and general information session) with WPI Admissions department
- Another Field Trip to WPI for more demonstrations
- Space Survey results presentation

WPI Breaks: March 2nd to 12th
May 2nd done

WPS Breaks :

School gets out :

What do the kids want to see:

Anything you want us to present on:

APPENDIX D:

Future Scientists and Engineers Club

Perspective Meetings

1. Chocolate Asphalt
 - Civil Engineering - A basic over view of road construction and different materials used in the process followed by making of asphalt from melted chocolate and other chocolate candy.
2. Lego Project Management
 - Civil Engineering and Project Management- An overview of what a project management and then a construction project with legos. Project goals would include building a tower with legos, surviving a wind test with that tower, and also keeping cost low with the amount of legos.
3. Gears, Cams, and Linkages
 - Mechanical Engineering- A look at many simple devices that are used in all types of machines.
4. Teraforming Mars
 - Biotechnology- Presentation on how different plants could be used to create oxygen on Mars.
5. Computer Science with Professor Gennert
 - Computer Science- A look into computer science from the head of the WPI department. Actual presentation focus undetermined.
6. Rehabilitation Engineering with Professor Ault
 - Rehabilitation Engineering- Look at the design process and helping people with disabilities have as much of a normal life as possible with the help of engineering. More details to be determined.
7. Robotics Demonstration with Ken Stafford
 - Robotics Engineering- A presentation using robots to show in a fun way the ability of robots.
8. Space presentation field trip at Ecoterium
 - A WPI sponsored field trip where WPI IQP presentations will be given at the Ecoterium in Worcester accompanied by a presentation by a member of the NASA Institute for Advanced Concepts.
9. Introduction to Engineering given by the WPI Admissions dept.
 - Overview of all the different typed of engineering accompanied with information about starting salary and the growing market for engineers.
10. Another Field trip to WPI
 - Field trip sponsored by WPI to give a tour of labs on campus and to give demonstrations on computer software unavailable at the Worcester Public High schools.
11. Space Survey results presentation
 - An overview of data gathered from a survey in Pennsylvania and in Worcester High Schools to show what high school students think about space.
12. Pizza Party
 - Final meeting with pizza and soda final questions from students can be answered.

APPENDIX E:

Doherty High School 2007 Future Scientist and Technologist Club

Advisor: Kathy Kambosos

WPI Team: Chris Norton and Orry Cummings

Meeting 1: Introduction and Egg Drop

For our first meeting of the year we had around thirty five students and introduced ourselves to the group and explained the purpose of our IQP. We then introduced our first activity the Egg Drop Lab. We told the students to create a device out of whatever they wanted to protect an egg from a fall. We talked about the engineering design process and let the students create sketches of three designs. We walked around the room speaking with students about their design concepts and materials. The students were told to construct their top design for the next week's meeting.

Meeting 2: Egg Drop Test and Chocolate Asphalt

In this meeting the Egg Drops created over the week break between meetings were tested and one winner was crowned. About 10 total egg drops were constructed and only one passed the final test. After the test we spoke about design flaws and how the designs could have been improved. Also how these problems could have been corrected before testing through more work in the design process. After that was complete we stated the chocolate asphalt lab where we spoke about civil engineering and asphalt paving. We gave all the students melted chocolate to represent liquid asphalt and other chocolate candy to represent aggregate. They mixed their own asphalt and took it home to dry and eat.

Meeting 3: Roller Coaster Lab

In our third meeting we changed gears and had a meeting related entirely to physics. We discussed the principles of conservation of energy, kinetic and potential energy, and g force. We went through an example of a roller coaster being designed using kinetic energy to solve for velocities, accelerations and g forces. Then the students were asked to design their own small roller coaster using loops and humps and calculate the g force at the elements to make sure the roller coaster was safe.

Meeting 4: Admissions

WPI admissions cam in during this meeting to talk to the students about a possibly coming to college at WPI and just getting into an engineering school in general. All different types of engineering were explained to the students to show the wide range of areas engineering encompasses.

Meeting 5: Project Management

In this lab the students were given the task of building a structure out of Legos. They were told to make it tall and able to withstand a wind test while also staying under budget. All the Legos were given price values. Once the students had constructed their towers they were tested with a fan to make sure they were stable and a point system was used to find a winner. Then we talked with the students about the things they should have done differently and what they did not expect going in to the lab.

Meeting 6: Field Trip to WPI

For our field trip we organized for the students to come to WPI for the Pugwash space conference. The students first got a talk from admissions about WPI and the project system offered here. They were then given a tour of WPI. Then the space conference began and they saw WPI IQP group's projects on the future of space. They saw presentations on growing potatoes on the moon, what a future moon settlement would look like, future space propulsion systems, and how gasses could be harvested from the atmosphere to support these settlements. The students were also given lunch at WPI and then sent back to their schools by the end of the day.

Meeting 7: Pizza Party

For our last meeting we just had a pizza party with the students and just talked with them on a more personal level. We also got to talk to the students about what they liked about the club and what they didn't and also talked about the field trip we had the week before.

APPENDIX F:
Proposal Draft #1
The Worcester Future Scientist and Engineer Clubs:
A Proposal to be reviewed by ...

Last year Duncan and Dorchik (June, 2006) ran a pilot project at Doherty High School on the possibility of establishing Future Scientist and Technologist clubs in the Worcester Public Schools. This year that pilot program has been expanded into five teams of two students that will be setting up clubs at five different high schools, Doherty, Burncoat, North, South, and Worcester Technical High School. Advisors have been designated at all the schools and they will start in WPI's D Term, at the latest. This would make time for a two month long program with one meeting a week with a field trip to WPI included as one of those meetings.

Some of the meeting topics last year such as a general overview of the different areas of engineering and a robotics demonstration would be included again in our meetings. Also our group has been working with our advisor John Wilkes on many new ideas for meetings such as presentations on assistive technology, materials, space exploration, asphalt properties and mixing, and a design challenge. These proposed meetings show many different aspects of engineering and the high school club advisors have responded well to most of them. Some of the advisors like Joseph Marzilli and Brian Morse of North High are both WPI alumni and have agreed to advise the club there at North, with or without "overtime" pay. However, most of the principals are saying that no pay is available, and not all advisors can donate their time.

To fund this club each group member is going to contribute seventy five dollars over the course of our three term IQP. We would like to ask WPI to provide one hundred

dollars for each group member to supplement the donation of seventy five dollars of our own. Thus each two person team will have a “WPI” budget of three hundred and fifty dollars per term. Along with the money WPI and our group is supplying we will also ask the Worcester Public School system to match WPI’s investment to the club of two hundred dollars per club. This would give us a budget of two thousand seven hundred and fifty dollars for the five clubs. This allows for over twelve hours of time with the high school advisors to the club. We would like to spend eight of those hours in the club and four for outside meetings with the advisors to organize for meetings, and go on a field trip.

The main resource requirement for the club project involves union rules for WPS teachers. They must be paid thirty dollars an hour for “overtime” – after hours teaching and advising. Last year the WPS first promised the money for two clubs and then rescinded the offer due to budget cuts. To protect the project we plan to fund the club for a minimum “honorarium” from WPI of two hundred dollars, per advisor and still have seven hundred and fifty dollars for busses to have a field trip to WPI. This will cover an hour a week for seven actual club meetings, and five meetings to plan, debrief, and do other things such as recruit and assess. A request will also be submitted to WPS for two hundred dollars per club, but that will be to cover transportation for a second field trip, special events, and other expenses including a party for the last club meeting. These are things we can do without if we have to do so, though they would greatly enhance the program. Thus, if WPS again runs out of funds and cuts all the “frills”, the project can go forward on a “staff” and WPI trip only budget. If they come through each club will have

a five hundred and fifty dollar budget. We expect to cost share the project with WPI, as noted above.

We believe that this project could be very important for the city of Worcester, and help WPI enhance the engineering profession. Many people would garner the benefits of these clubs. All ten of us are eager to get started. If we want these club programs to be as extensive as we explained we must know we have advisor pay and can get to WPI at least once at the time of a student Pugwash conference on space technology and the return to the moon tentatively scheduled for early April. We know we can get these clubs off the ground, if we can get the WPS faculty advisors to commit enough time without your assistance we will not be able to assure them that they will get at least token payment for their time, and get to use WPI resources at least once.

Field Trip To WPI

If possible, our team feels it would be of great benefit to the clubs to visit the WPI campus and take a guided tour which could include presentations from faculty and students. One area of interest which we feel would be both entertaining and informative would be a demonstration of WPI's CNC machine capabilities. Though an agreement with Haas, WPI receives a certain number of CNC machines during an allotted period in time provide that specified amounts are also purchased. This appears to be a point of attraction for the school as it is mentioned during campus tours, which most potential students choose to go on.

It is because of this popularity that we feel a CNC machine demonstration would be a positive experience for the students involved. The discussed idea we have involves the repeating party of the lab portion of the class which most WPI student take, ME1800. The majority of this lab is spend learning computer programs associated with CNC machinery as well as how to operate the machines. The goal of this is for the students to machine a Sterling engine. Similarly, this would be a demonstration provide for the students participating in the Science and Technology club. While it is unrealistic to expect them to learn these computer programs, it would be a simple exercise to run a pre-constructed program to demonstrate how the CNC machine cuts the metal into the shape specified by the user. Upon completion, the club would be able to bring their fully functional Sterling engine back to their high school as a souvenir.

In order to ensure that such a demonstration is possible, we must arrange for an individual with knowledge of both CNC machine operation as well as the Sterling engine project to be available. While we have not receive positive confirmation from any

individuals, it is possible that the demonstration could be given by a ME1800 lab teacher, a student involved in the MQP project attempting to fabricate all elements of the engine on campus, or even one of our group members. There are a number of individuals qualified to perform such a demonstration. Ms. Kambosos hopes that the proper arrangements can be made, since she found the idea attractive.

In order to put on this demonstration, our group will need funds to arrange for transportation as well as material fees associated with the demonstration. We plan to make this presentation dependant on WPS coming though with their portion of the funding for the project. However, some of the club advisors are interested in considering other possible field trips, such as to the New England Ecotarium.

Budget

Requirement for one H.S. club run by two students

- $\$30/\text{hour} \times 12 \text{ hours} = \360
- Student contribution of \$150
- Requested WPI contribution \$200

Total WPI Contribution of \$1000

Total club budget of \$2750

Cost Sharing with WPS

- Request of \$1000 from WPS

Combine budget with WPS contribution \$3750

Budget covers

- Advisors Salary $\$360 \times 5 = 1800$
- Field Trip to WPI $\$150 \times 5 = 750$
- Second Field Trip $\$150 \times 5 = 750$
- Honarin and Supplies $= \underline{450}$
 \$3750

APPENDIX G:
Proposal Draft #2
The Worcester Future Scientist and Technologist Clubs:
A Proposal to be reviewed by Richard F. Vaz

Last year Duncan and Dorchik (June, 2006) ran a pilot project at Doherty High School on the possibility of establishing Future Scientist and Technologist clubs in the Worcester Public Schools. This year that pilot program has been expanded into five teams of two students that will be setting up clubs at five different high schools, Doherty, Burncoat, North, South, and Worcester Technical High School. Last year a field trip was talked about but was never actually done this year a field trip to WPI was made possible by our IQP team. Our field trip included an admissions talk about WPI and the projects program, an admissions guided tour of campus, and the Pugwash space conference. The Pugwash space conference showcased many WPI IQP groups which did projects on the future of space. The presentations showed new technologies being developed now and what a future space station on the moon would look like and how it would function. The trip was set up to excite the students interest in engineering which is the clubs main goal and also to get the students interested in a career in new space opportunities as an option for their future. This field trip brought about eighty students from the Worcester high schools to WPI and further stimulated their interest in engineering. Our team thinks that this was a very valuable experience for the students and wants this type of trip to be done annually.

We are requesting that WPI reimburse our group for the busses for the trip which totaled three hundred dollars. All other expenses of the group have been covered by our group members themselves and have definitely amounted to the two hundred and twenty five dollars that each member is supposed to spend for the three term IQP. We would

greatly appreciate the help of WPI in funding for the busses to lessen the strain on us for money. Without this help it would be very hard to get the clubs next year to organize and follow through with a similar trip to WPI. With the momentum we currently have with these high school clubs it would be a shame is the IQP group next year working with these clubs was not able to achieve this field trip again after the success we had this year.

APPENDIX H:

Egg Drop Experiment

Objective: Create a device that can hold an egg and protect it from breaking while it is subjected to a series of falls.

Checkpoints: Survive a fall from 5ft
Survive a fall from the ceiling
Survive a throw into the air
Survive a kick

Rules: Must fit into a one foot square box
Any materials can be used
No weight requirements
No parachutes or balloons
Must be able to take the egg out quickly between trials to be checked for cracks

Theory: When an egg falls on the ground it breaks because it is stopped instantly. The device you create should slow the eggs motion down over a greater amount of time therefore lowering the acceleration of the egg and keeping it from cracking.

Design Concepts:

--	--	--